

Registration No.:

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Total Number of Pages: 02

Course: MCA
Sub_Code: MCHS1002

2nd Semester Regular/Back Examination: 2025-26
SUBJECT: Universal Human Values & Professional Ethics
BRANCH(S): MCA
Time: 3 Hours
Max Marks: 100
Q.Code: V319

Answer Q1 (Part-I) which is compulsory, any eight from Part-II, and any two from Part-III.
The figures in the right-hand margin indicate marks.

Part-I

- Q1** **Answer the following questions:** (2 x 10)
- a) Are 'Acceptance' and 'Natural Acceptance' the same or different. Justify your answer with a suitable example.
 - b) Why is right understanding required in relationships for mutual happiness? Illustrate with the help of two examples from your life.
 - c) What are the basic human aspirations and what are the requirements to fulfil them? Indicate their correct priority.
 - d) Distinguish between the needs of self and body. Are you working for both these needs. Which need is having higher priority according to you and why?
 - e) Define self-regulation. How does it lead to prosperity and health for human being?
 - f) Define "Trust" and "Respect" in human-to-human relationships. What happens in the absence of these two feelings in a relationship?
 - g) What is the meaning of 'universal human order'? What is its scope?
 - h) Give some examples of units that only have the activity of recognising and fulfilling.
 - i) Distinguish between units and space.
 - j) What do you understand by the term's 'profession' and 'professional ethics'?

Part-II

- Q2** **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** (6 x 8)
- a) Explain the basic guidelines for Value Education. What is the need for these guidelines?
 - b) What do you mean by self-exploration? Explain with suitable sketch. Apply the concept of self-exploration to resolve a personal conflict using suitable examples.
 - c) Why is right understanding required for ensuring physical facilities? How does it result in mutual prosperity? Illustrate with the help of two personal examples. How is it related to 'animal consciousness' and 'human consciousness'?
 - d) "I am the seer, doer and enjoyer. The body is an instrument". Explain with one example of each. Explain what is meant by right utilization of body? Explain how the assumption "Human Being = Body", leads to the feeling of deprivation.
 - e) Distinguish between "intention" and "competence". What is the outcome when we confuse between the two and we doubt the intention of the others? What is the outcome when we are able to see them separately and we trust the intention of the other?
 - f) The minimum content of respect is to be able to see the other person as being similar to you. On what basis is the other similar? What is the complete content of respect?

- g) Explain the feelings of care and guidance. What is excellence? Is working for competition the same as working for excellence? Explain with the help of examples.
- h) Why is storage required in a society? Suggest any two ways in which you can store the produce for right utilization in the future.
- i) There are three kinds of obsession. List them. Give any three examples of each from your observations in the society.
- j) The four orders in nature have been classified on the basis of their distinct activities, innateness, natural characteristics and inheritance. Explain with one example for each order.
- k) How do you explain the differences found in the ethical perceptions of different cultural and religious traditions?
- l) In spite of the increasing number and stringency of measures to curb corruption, this malaise is ever growing. Explain the reason and possible solution for this situation.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

- Q3** "Skills are definitely required. However, along with skills, value education is also essential." Comment on it. Critically evaluate the effectiveness of holistic value-based education in modern technical education systems with suitable examples. In your answer, address the following aspects: (16)
- a) Analyse the limitations of the current skill-oriented education system in achieving a holistic vision of life. Explain the need and significance of value education in technical, professional, and personal contexts.
 - b) Discuss the significance of Education-Sanskar for Human Order.
 - c) Evaluate the impact of value education on students' ethical behaviour, professional competence, and social responsibility.
 - d) Propose suitable measures to enhance the integration and effectiveness of value education in technical institutions.
- Q4** Examine the sources of imagination and their impact on human behaviour and work. In your answer, address the following aspects: (16)
- a) Identify and explain the possible sources of imagination.
 - b) Analyse the consequences of imagination arising from each of these sources.
 - c) Evaluate how these sources of imagination influence human work, decisions, and behavior.
 - d) Propose a systematic approach to ensure harmony in the self.
- Q5** Discuss the basis of harmony in the family and the role of values (feelings) in ensuring mutual happiness in relationships. In your answer, address the following aspects: (16)
- a) Explain the basis of harmony in a family and discuss whether relationships can be understood with definiteness.
 - b) Identify and explain the nine values (feelings) in relationship essential for maintaining harmony in relationships.
 - c) Analyse how the fulfilment and right evaluation of feelings in relationships lead to mutual happiness.
 - d) Appraise the current status of family relationships in society and suggest measures for improvement.
- Q6** Assess the expression of co-existence at different levels in nature and the role of human beings in maintaining harmony in existence. Explain the concept of co-existence and its expression at various levels of existence. Analyse the interrelationship and mutual fulfilment among the different orders in nature. Evaluate the role and responsibility of human beings in ensuring harmony within existence. (16)

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Total Number of Pages: 03

Course: MCA
Sub_Code: MCPC1005

2nd Semester Regular/Back Examination: 2025-26
SUBJECT: Object-Oriented Programming using JAVA

BRANCH(S): MCA

Time: 3 Hours

Max Marks: 100

Q.Code: V358

Answer Q1 (Part-I) which is compulsory, any eight from Part-II, and any two from Part-III.
The figures in the right-hand margin indicate marks.

Part-I

Q1 Answer the following questions:

(2 x 10)

- a) Define JVM. What is its role in Java program execution?
- b) What is the output of the following code?

```
public class Main {  
    public static void main (String [] args) {  
        String s1 = "Java";  
        String s2 = new String("Java");  
        System.out.println(s1 == s2);  
        System.out.println(s1. equals(s2));  
    }  
}
```
- c) Can we overload the main() method? Justify.
- d) Define method overriding. How does it differ from method overloading?
- e) When is the final keyword used with a method and a class?
- f) Define thread. What is its life cycle in Java?
- g) Why is finally block used? Is it always executed?
- h) What is the difference between Thread class and Runnable interface?

i) What is the output?

```
class Parent {  
    void show () { System.out.println("Parent");}  
}  
class Child extends Parent {  
    void show () { System.out.println("Child");}  
}  
public class Main {  
    public static void main (String [] args) {  
        Parent p = new Child ();  
        p.show();  
    }  
}
```

- j) What is the difference between JCheckBox and JRadioButton?

Part-II

Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve) (6 x 8)

- a) Describe the role of constructors in Java. Explain default constructor, parameterized constructor, copy constructor, constructor chaining using this () and super (), and the difference between constructor and method.
- b) Write a complete Java program to demonstrate the following array operations:
 - i. Create and initialize a 3×3 matrix
 - ii. Find sum of all elements
 - iii. Find transpose of the matrix
 - iv. Find largest element in each row
- c) Why is Java called platform-independent? Explain the role of bytecode and JVM in achieving platform independence. Compare compilation and interpretation in Java.
- d) What is the difference between abstract class and interface? When would you use each? Explain with real-world examples. Can an interface extend another interface? Can a class implement multiple interfaces?
- e) Write a Java program to demonstrate multilevel inheritance. Create classes: Animal (name, eat ()), Mammal (breed, walk ()), Dog (bark ()). Show how child class accesses parent members using super.
- f) Write a program to demonstrate method overriding and dynamic method dispatch. Create a base class Shape with method area (). Derive Circle, Rectangle, Triangle, and override area (). Create an array of Shape references pointing to different objects and compute areas polymorphically.
- g) Explain the exception hierarchy in Java. Differentiate between checked exceptions, unchecked exceptions, and errors with examples. List 5 built-in exceptions from each category.
- h) Write a complete Java program demonstrating nested try-catch blocks, multiple catch blocks, finally block, and throw keyword. Show handling of ArithmeticException, ArrayIndexOutOfBoundsException, and NullPointerException.
- i) Compare creating threads by extending Thread class vs. implementing Runnable interface. Which is better and why? Explain with scenarios.
- j) Explain the Swing component hierarchy. Differentiate between AWT and Swing comprehensively (heavyweight vs. lightweight, MVC pattern, pluggable look-and-feel, performance).
- k) Explain inner classes in Java. Describe four types: member inner class, local inner class, anonymous inner class, static nested class. How are anonymous inner classes useful in event handling?
- l) What are adapter classes? Why are they introduced? List 5 adapter classes with their corresponding listener interfaces. Write code using MouseAdapter instead of MouseListener.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

- Q3** Explain the complete architecture of JVM (Java Virtual Machine) in detail. Include: **(16)**
- i. Class Loader Subsystem (Loading, Linking, Initialization)
 - ii. Runtime Data Areas (Method Area, Heap, Stack, PC Registers, Native Method Stack)
 - iii. Execution Engine (Interpreter, JIT Compiler, Garbage Collector)
 - iv. Draw a neat block diagram and explain the role of each component in bytecode execution.

- Q4** Explain the Event Delegation Model (EDM) in detail with components: Event Source, Event Listener, Event Object. List all event classes and listener interfaces with their methods. Describe the following Swing containers in detail: JFrame, JDialog, JWindow, JPanel, JScrollPane, JTabbedPane, JSplitPane. Explain their default layouts and usage. **(16)**
- Q5** Write a complete Employee Management System using inheritance: **(16)**
Create abstract class Employee with fields: empId (static auto-generated), name, basicSalary, joiningDate
Abstract methods: calculateSalary(), getDesignation(), getRole()
Derived classes: Manager (bonus 20% of basic), Developer (project allowance 10k), Trainee (stipend 15k fixed for 6 months)
Use constructor chaining using super ()
Override toString() to display all details
Create class HRDepartment with methods: addEmployee(), displayAllEmployees(), findHighestPaid(), employeesByDesignation()
In main: create array of 10 different employees, compute monthly salary, display all
Use dynamic method dispatch to call calculateSalary()
- Q6** Explain the complete thread lifecycle with a state transition diagram. Describe each state: New, Runnable, Running, Blocked, Waiting, Timed Waiting, Terminated. What causes transitions? Explain inter-thread communication using wait(), notify(), and notifyAll() methods. Why are these methods defined in Object class? Write a producer-consumer problem explanation. **(16)**

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Total Number of Pages: 02

Course: MCA
Sub_Code: MCPC1006

2nd Semester Regular/Back Examination: 2025-26

SUBJECT: Software Engineering

BRANCH(S): MCA

Time: 3 Hours

Max Marks: 100

Q.Code: V376

Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II, and any two from Part-III.

The figures in the right-hand margin indicate marks.

Part-I

Q1 Answer the following questions: (2 x 10)

- a) Define software engineering and explain its layered technology.
- b) Differentiate between waterfall and spiral models.
- c) What is a process framework?
- d) Explain functional and non-functional requirements with examples.
- e) What is a use case diagram?
- f) Define object-oriented design.
- g) What is black-box testing?
- h) Differentiate between alpha and beta testing.
- i) What is software reliability?
- j) Explain ISO 9000 quality standards in software engineering.

Part-II

Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve) (6 x 8)

- a) Explain incremental process models with an example.
- b) What are the problems in requirement elicitation?
- c) Draw a simple data flow diagram (DFD) for an online shopping system.
- d) Explain CRC cards in requirement analysis.
- e) Discuss guidelines for efficient coding.
- f) Explain integration testing (top-down vs bottom-up).
- g) What is validation testing?
- h) Explain software risk projection with an example.
- i) What is software quality assurance?
- j) Explain risk refinement in software projects.
- k) Differentiate between software availability and maintainability.
- l) What is a decision table? Provide a small example.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

- Q3** a) Compare evolutionary process models with the unified process. (8)
b) Prepare a process model for a hospital management system, highlighting phases, and deliverables. (8)
- Q4** a) Perform requirement analysis for a library management system. Identify functional and non-functional requirements. (8)
b) Prepare a Software Requirement Specification (SRS) document outline for the same. (8)
- Q5** a) Design an object-oriented model for an online banking system. (8)
b) Explain cohesion and coupling in the context of your design. (8)
- Q6** a) Prepare a test plan for a mobile application including unit, integration, and system testing. (8)
b) Discuss software risk management strategies with examples from the same application. (8)

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Course: MCA
Sub_Code: MCPC1007

2nd Semester Regular/Back Examination: 2025-26

SUBJECT: Data Structures

BRANCH(S): MCA

Time: 3 Hours

Max Marks: 100

Q.Code: V444

Answer Q1 (Part-I) which is compulsory, any eight from Part-II, and any two from Part-III.
The figures in the right-hand margin indicate marks.

Part-I

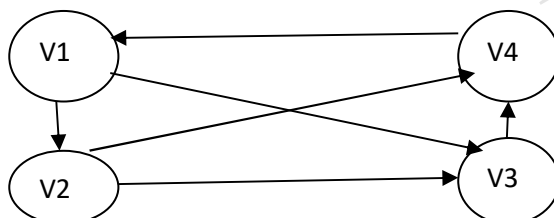
Q1 Answer the following questions: (2 x 10)

- Define time and space complexity for an algorithm.
- What do you mean by Abstract Data Type (ADT)? Give an example.
- Write the pseudo-code for push operation on a stack.
- Evaluate the expression: $2^4 + 6 * 2^2 - 12$
- What is the difference between linear data structure and non-linear data structure?
- What is reverse polish notation? Give an example.
- What are the techniques used for traversing a tree?
- Write the pseudo-code for underflow condition in a queue.
- What is a graph? How to represent a graph? What is a self-loop in a graph?
- If an array is declared as $a[5][5]$, how many elements does it contain? Also show the memory representation of the array.

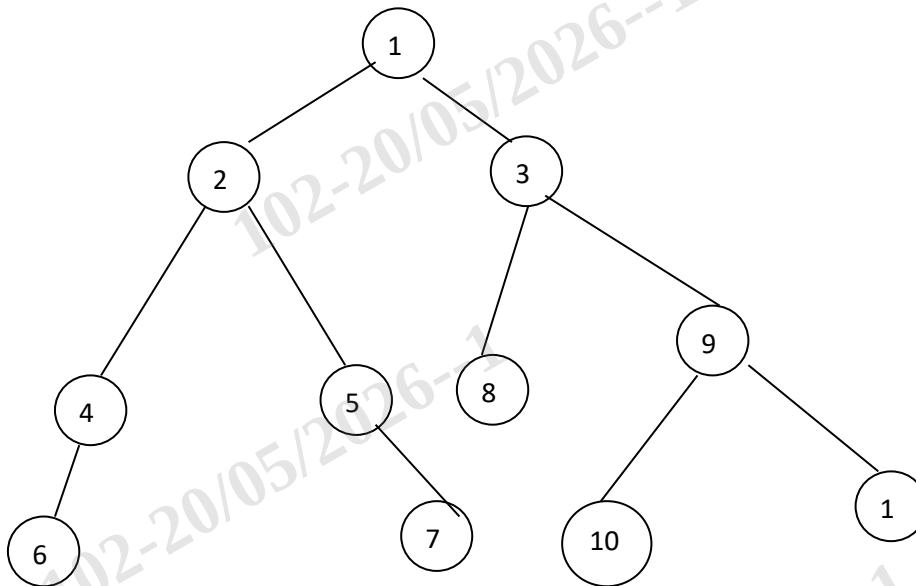
Part-II

Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve) (6 x 8)

- Evaluate the postfix expression: $P = 12, 7, 3, -, /, 2, 1, 5, +, *, +$
- What is a binary search tree? Differentiate between complete binary tree and almost complete binary tree.
- Write the pseudo-code for deleting an element from the beginning of an array.
- Describe about the parameters required for comparing the performance of an algorithm.
- Convert the following expression from post-fix to infix using Stack: $AB - C + DEF - + /$
- Define a linked-list. Describe the types of linked-lists.
- Given the following graph, find the No. of edges, No. of vertices, degree of each vertex, in-degree of each vertex, out-degree of each vertex:



- h) Find the preorder, in-order, and post-order traversal for the following tree:



- i) Write the pseudo code for inserting a node in the middle of a single linked-list.
- j) Construct the BST from the given sequence: 11, 6, 8, 19, 4, 10, 5, 17, 43, 49, 31
- k) Explain the insertion and deletion operations in a queue. Explain the types of queues along with their applications.
- l) Write the pseudo-code to delete a node from the end of a double linked-list.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

- Q3** What is bucket sort? Perform sorting operation of the following sequence of numbers by using Bucket Sort: 15,1,321,10,802,2,123,90,109,11 (16)
- Q4** a) What is Heap? Differentiate between min-heap and max-heap. (8)
 b) Compare Quick Sort and Heap Sort in terms of complexity by taking an example. (8)
- Q5** a) What are the techniques used to search an element from a given array? Describe with the pseudo codes and example from each. (8)
 b) Write a C program to search an element using Linear Search. Explain the working of the program step-wise by giving an example. (8)
- Q6** What is the difference between merging and merge sort? (8)
 What is the meaning of sorting? Differentiate between sorting and searching. (8)

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Total Number of Pages: 02

Course: MCA
Sub_Code: MCPC1008

2nd Semester Regular/Back Examination: 2025-26
SUBJECT: Computer Organization and Architecture
BRANCH(S): MCA
Time: 3 Hours
Max Marks: 100
Q.Code: V514

Answer Q1 (Part-I) which is compulsory, any eight from Part-II, and any two from Part-III.
The figures in the right-hand margin indicate marks.

Part-I

Q1 Answer the following questions:

(2 x 10)

- Differentiate between clock cycles and clock frequency.
- Differentiate between write back and write through in cache memory.
- Explain the concept of virtual memory.
- What is page replacement? Why is it required?
- What do you mean by 2D Memory organization?
- What is arithmetic and logic unit?
- Let the number of instructions be $n = 64$. Find the speedup value for a 4-segment linear pipeline.
- Differentiate between Array and Vector processors.
- Why cache memory is faster than main memory?
- How does computer organization affect the performance of the computer?

Part-II

Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)

(6 x 8)

- A benchmark program is run on a 40 MHz processor. The executed program consists of 100,000 instruction executions, with the following instruction mix and clock cycle count:

Instruction Type	Instruction Count	Cycles per Count
Integer arithmetic	45000	1
Data Transfer	32000	2
Floating Point	15000	2
Control Transfer	8000	2

Determine the effective CPI, MIPS Rate, and execution time for this program.

- List and briefly explain the components of a computer system.
- Explain the Flynn's classification of Computer systems.
- What is Pieplining? A 5-stage pipeline has stage delays of 150 ns, 120 ns, 150 ns, 160 ns, and 140 ns. Inter-stage register delay is 5 ns. Calculate the total time to execute 100 instructions and the speed-up over a non-pieplined processor.

- e) Define Cluster Computing and Explain its key benefits.
- f) What is Cache Mapping? Why is it required? Explain the mapping techniques with an example from each.
- g) Describe different techniques for reducing Cache Misses.
- h) Differentiate between Superscalar, Super-pipelined, and VLIW Processor architectures. Which one among them is more powerful? Explain with an example from each.
- i) Explain different memory page replacement policies with an example.
- j) Differentiate between Centralized shared-memory architecture and Distributed shared-memory architecture.
- k) Briefly describe about different types of memory of a computer system along with the hierarchical memory structure.
- l) Describe about different Pipeline optimization techniques.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

- Q3** A digital computer has a memory unit of 64 K x 16 and a cache memory of 1K words. The cache uses direct mapping with a block size of four words. **(16)**
- a) How many bits are there in the tag, index, block, and word fields of the address format?
 - b) How many bits are there in each word of the cache, and how are they divided into functions? Include a valid bit.
 - c) How many blocks can the cache accommodate?
- Q4** A virtual memory system has an address space of 8 K words, a memory space of 4 K words and page and block size of 1 K words. The following page reference changes occur during a given time interval. **(16)**
- 4, 2, 0, 1, 2, 6, 1, 4, 0, 1, 0, 2, 3, 5, 7. Compute the hit ratio and miss ratio. Also compute the number of page faults for each algorithm.
- Determine the four pages that are resident in main memory after each page reference change if the replacement algorithm used is: (a) FIFO (b) LRU (c) Optimal
- Q5** Define an Interconnection Network. Differentiate between Static and Dynamic Interconnection Networks. Explain different types of Interconnection Networks that are used in case of multi-processors. Explain the properties of Interconnection Networks. **(16)**
- Q6** Identify the various data hazards that occur in the following set of instructions: **(16)**
- | | |
|-----------------|------------------------------|
| ADD #20, R0, R1 | $R0 + 20 \rightarrow R1$ |
| MUL #3, R2, R3 | $R2 * 3 \rightarrow R3$ |
| AND #6, R2, R4 | $R2 \wedge 6 \rightarrow R4$ |
| ADD R0, R4, R5 | $R0 + R4 \rightarrow R5$ |
| SUB R1, R3, R6 | $R1 - R3 \rightarrow R6$ |
| DIV R4, R5, R3 | $R4 / R5 \rightarrow R3$ |
- Initially, registers R0 and R2 contain 2000 and 50, respectively. These instructions are executed in a computer that has a four-stage pipeline. Note that Instruction Fetch (IF) requires only 1 cycle.
- (a) Draw the timing diagram for the above execution.
 - (b) Explain how these data hazards can be overcome.

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Total Number of Pages: 02

Course: MCA
Sub_Code: MCPC1009

2nd Semester Regular/Back Examination: 2025-26

SUBJECT: Theory of Computation

BRANCH(S): MCA

Time: 3 Hours

Max Marks: 100

Q.Code: V529

Answer Q1 (Part-I) which is compulsory, any eight from Part-II, and any two from Part-III.
The figures in the right-hand margin indicate marks.

Part-I

Q1 Answer the following questions: (2 x 10)

- Define the ϵ -closure of a state in a Non-deterministic Finite Automaton.
- State the fundamental difference in computational power (if any) and state transition behavior between a DFA and an NFA.
- State any two algebraic laws of regular expressions with a brief example.
- What is the primary theoretical application of the Pumping Lemma for Regular Languages?
- Define ambiguity in a Context-Free Grammar (CFG).
- Identify the structural difference in the memory model of a Pushdown Automaton (PDA) compared to a standard Finite Automaton (FA).
- What is closure property of regular languages?
- Briefly define a recursively enumerable language in the context of Turing Machines.
- Mention the various extension to the basic Turing Machine.
- List any two mathematically undecidable problems regarding Turing Machines.

Part-II

Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve) (6 x 8)

- Design a Deterministic Finite Automaton (DFA) that accepts the language over the alphabet $\Sigma = \{0, 1\}$ containing the specific substring "011". Draw the transition diagram.
- Explain the subset construction algorithm used to convert a Non-deterministic Finite Automaton (NFA) to an equivalent Deterministic Finite Automaton (DFA).
- Construct a Finite Automaton to accept strings over $\Sigma = \{a, b\}$ such that the number of 'a' s is even and the number of 'b' s is a multiple of 3. Briefly explain your state logic.
- Prove mathematically that the language $L = \{a^n b^n \mid n \geq 0\}$ is not a regular language by applying the Pumping Lemma.
- Formulate a Regular Expression for the language of all strings over $\{0, 1\}$ that do not end with the sequence "10". Justify the logic behind your expression.
- Discuss the closure properties of regular languages. Specifically, prove or explain why regular languages are closed under the union and intersection operations.

- g) Explain ambiguity in CFG. Consider the grammar $E \rightarrow E + E \mid E^*E \mid \text{id}$. Demonstrate that this grammar is ambiguous by drawing two distinct parse trees for the target string: $\text{id} + \text{id} * \text{id}$.
- h) Outline the step-by-step algorithm to convert a given Context-Free Grammar to Chomsky Normal Form (CNF). Apply the steps to the given grammar for obtaining the CNF:
 $S \rightarrow aSb \mid \epsilon$
- i) Design a Pushdown Automaton (PDA) to accept the language $L = \{wcw^r \mid w \in \{a, b\}^*\}$, where w^r represents the reverse string of w . Explain the stack operations in your design.
- j) Describe advanced programming techniques for Turing Machines. Focus your explanation on the concepts of "shifting over" and "using multiple tracks" for complex computations.
- k) Explain the Halting Problem for Turing Machines. Formulate a logical argument demonstrating why no algorithm can be written to universally solve the Halting Problem.
- l) Differentiate conceptually between Recursively Enumerable languages and Non-Recursively Enumerable languages. Provide an example of a language that is not recursively enumerable and justify its placement.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

- Q3** a) Design a Deterministic Finite Automaton (DFA) suitable for a basic lexical analyzer that recognizes valid C-style identifiers (starting with a letter/underscore, followed by any number of letters/digits/underscores) and integer constants. Show the transition table and diagram. (8 + 8)
- b) Describe the Table-Filling Method (Myhill-Nerode theorem implementation) for minimizing the states of a DFA. Explain using a suitable example.
- Q4** a) Construct a finite automaton mathematically equivalent to the regular expression $(0 + 1)^*(00 + 11)^*(0 + 1)$. Utilize Thomson's construction method and show the step-by-step combinations of the NFA. (8 + 8)
- b) Evaluate the decision properties of regular languages. Formulate a programmatic algorithm/approach to rigorously decide whether two regular languages L_1 and L_2 (given as DFAs) are entirely equivalent.
- Q5** a) Design a Context-Free Grammar (CFG) for the following language. Explain the derivation logic used to handle the strictly "greater than" and "less than" scenarios. (8 + 8)
- $$L = \{a^n b^m \mid n \neq m \text{ where } n, m \geq 0\}$$
- b) Establish the formal equivalence between Pushdown Automata (PDA) and Context-Free Grammars (CFG). Outline the systematic algorithm required to convert any given CFG into an equivalent PDA.
- Q6** a) Design a Turing Machine that computes the 2's complement of a binary number presented on its tape. Provide the formal tuple definition, draw the complete state transition diagram, and thoroughly explain the tape head movement logic from right to left. (10 + 6)
- b) Write a comprehensive technical note on the Post's Correspondence Problem (PCP). Given two lists $A = \{10, 011, 101\}$ and $B = \{101, 11, 011\}$, logically deduce if a valid PCP match sequence exists and justify your conclusion.